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MICROWAVE REMOTE SENSING OF SEA ICE

by

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The long term objectives of this research project are as follows: a) to understand the physics of the multispectral microwave radiative characteristics of sea ice as it goes through different phases: b) to improve characterization of sea ice cover using satellite microwave sensors: and c) to study ice/ocean physical and biological processes associated with polynya formations and variability of the marginal sea ice region.

Two field experiments have been conducted to pursue these objectives. One involved measurements of radiative and physical characteristics of sea ice from a ship during a 3-month long cruise through the Weddell Sea ice pack during the Austral winter of 1986. The other involved similar measurements from two aircrafts and a submarine over the Central Arctic and Greenland Sea region. The latter was done in collaboration with scientists from Goddard (Codes 672 and 675), JPL, and Scott Polar Research Institute. Both experiments were very successful. Preliminary results have already led to an enhanced understanding of the microwave signatures of pancake ice, nilas, first year ice, multiyear ice and effects of snow cover.

Coastal and deep ocean polynyas and their role in bottom water formation and ocean circulation have been studied using a time series of ice images from SMMR. A recurring Cosmonaut Sea polynya similar in characteristics but much smaller in size than the large Weddell polynyas in mid-1970's was discovered. A simple model shows that the size of the polynya is a strong factor that keeps it from persisting throughout a winter period.

An unsupervised cluster analysis of Arctic sea ice using SMMR and THIR emissivity and brightness temperature data has been implemented in collaboration with Code 636 personnel. The analysis indicates the existence of several unique and persistent clusters in the Central Arctic region during winter and that the sum of the area of these clusters excluding those of first year ice is about 20% less than minimum ice cover area inferred from a previous summer data. This result is consistent with saline surface for some multiyear ice floes as observed during MIZEZ and suggests that a significant fraction of multiyear ice floes in the Arctic have first year ice signatures.

Current plans include the completion of analysis of the 1986 Weddell Sea data and the 1987 Arctic aircraft/submarine data and correlation of results with those of SMMR and the recently made available SSM/I data. The role of sea ice in the marginal ice zone phytoplankton bloom is also being studied using CZCS data in conjunction with SMMR data and in-situ observations. This is being done in collaboration with scientists from Goddard, University of Tennessee, and University of Southern California. A field program to measure radiative, electrical, and physical characteristics of Weddell Sea Ice is also scheduled to be conducted from June through July 1988 as part of the AMERIEZ project. These measurements will be utilized to further understand radiative characteristics of sea ice data at 85 GHz.

VERTICAL POLARIZATION

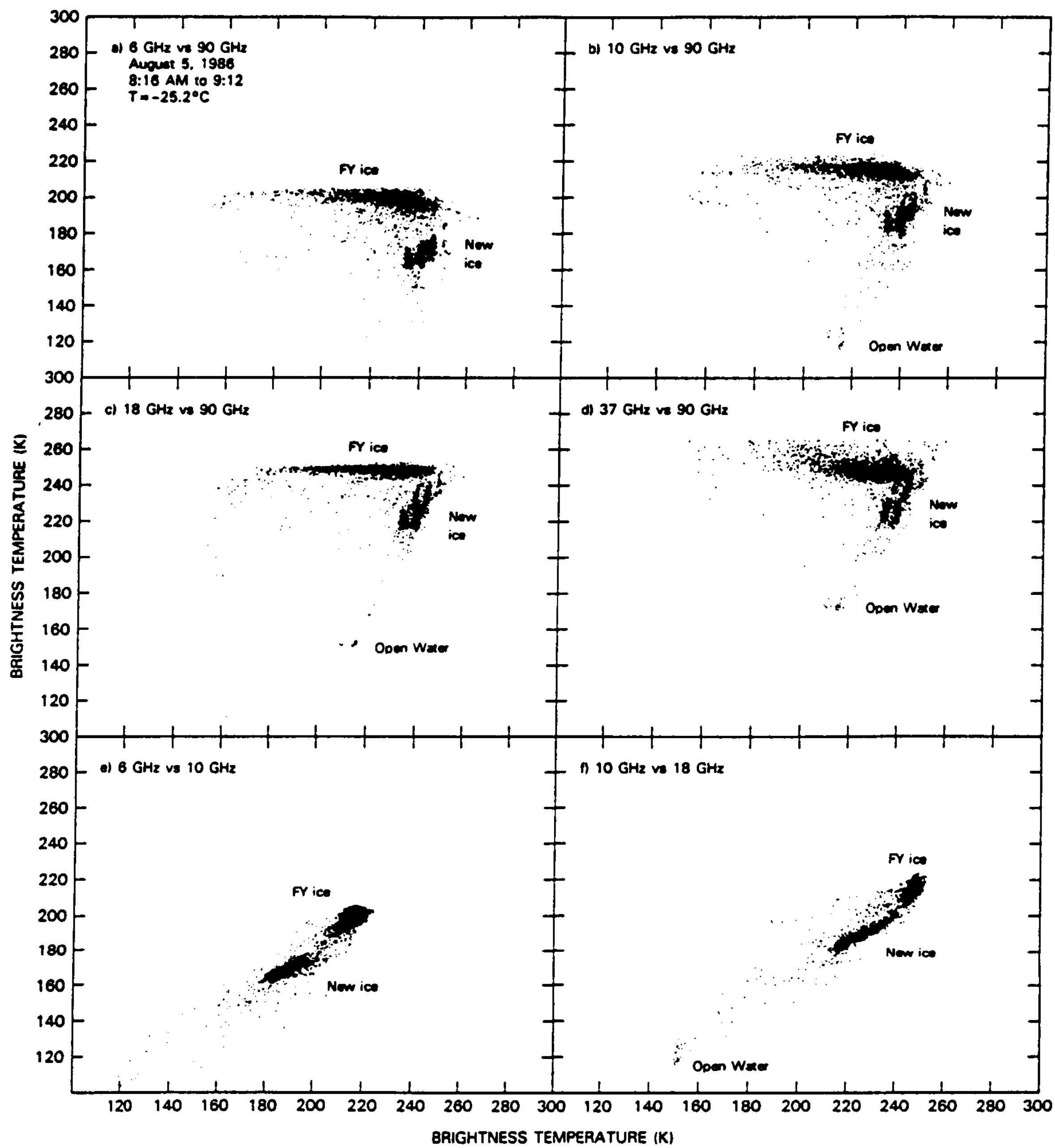

Figure 1. Multispectral passive microwave in-situ observations of Weddell Sea ice cover in Winter of 1986. The series of two-dimensional scatter plots using combinations of different channels at vertical polarization shows ability to discriminate new ice from snow covered and thick first year ice. New Ice from a polynya region are presented by distinct clusters which vary in number and relative position depending on which microwave channels are used in combination with the 90 GHz channel. Also, the use of a 90 GHz channel with another frequency channel also shows large sensitivity to different state and stages of snow cover in thick first year ice areas.